

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: Lee

Serial No.: 09/822,532

Filed: March 30, 2001

For: Method for Forming Aluminum Bumps by Sputtering and Chemical Mechanical Polishing

Group Art Unit: 1765

Examiner: Robert M. Kunemund

Commissioner for Patents

Alexandria, VA 22313-1450

TRANSMITTAL OF APPEAL BRIEF (PATENT APPLICATION-37 CFR 192)

1. Transmitted herewith, in triplicate, is the APPEAL BRIEF in this application, with respect to the Notice of Appeal Filed on July 17, 2003.

NOTE: "The Appellant shall, within 2 months from the date of the notice of appeal under §1.191(a) or within the time allowed for response to the action appealed from, if such time is later, file a brief in "triplicate", 37 C.F.R. 1.192(a) [emphasis added].

2. STATUS OF APPLICANT

This application is on behalf of:

X other than a small entity.

___ a small entity.

A verified statement:

___ is attached.

___ was already filed.

3. FEE FOR FILING APPEAL BRIEF

Pursuant to 37 CFR 1.17(f), the fee for filing the Appeal Brief is:

___ small entity \$160.00

X other than a small entity \$320.00

Appeal Brief fee due: \$ 320.00

Certificate of Mailing/Transmission (37 CFR 1.8(a))

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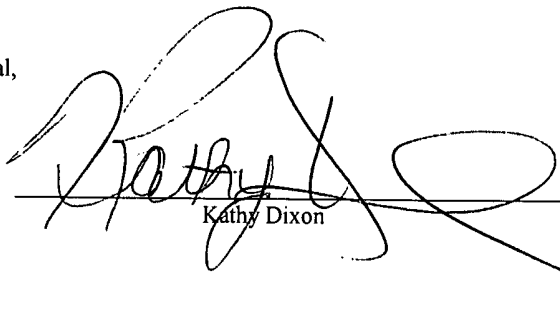
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Dated: Sept. 17, 2003


Kathy Dixon

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4. EXTENSION OF TERM

NOTE: The time periods set forth in 37 CFR 1.192(a) are subject to the provision of ☐ 1.136 for patent applications. 37 CFR 1.191(d). See also Notice of November 5, 1985 (1060 O.G. 27).

The proceedings herein are for a patent application and the provisions of 37 CFR 1.136 apply:

(complete (a) or (b), as applicable)

- (a) ☐ Applicant petitions for an extension of time under 37 CFR 1.136 (fees: 37 CFR 1.17(a)-(d) for the total number of months checked below:

	Extension (months)	Fee for other than small entity	Fee for small entity
<input type="checkbox"/>	one month	\$ 110.00	\$ 55.00
<input type="checkbox"/>	two months	\$ 390.00	\$195.00
<input type="checkbox"/>	three months	\$ 930.00	\$465.00
<input type="checkbox"/>	four months	\$1,470.00	\$735.00

Fee: \$ _____

If an additional extension of time is required, please consider this a petition therefor.

(check and complete the next item, if applicable)

- ☐ An extension for _____ months has already been secured, and the fee paid therefor of \$ _____ is deducted from the total fee due for the total months of extension now requested.

Extension fee due with this request: \$ _____

or

- (b) ☐ Applicant believes that no extension of term is required. However, this conditional petition is being made to provide for the possibility that applicant has inadvertently overlooked the need for a petition and fee for extension of time.

5. TOTAL FEE DUE

The total fee due is:

Appeal Brief Fee: \$ 320.00
Extension fee (if any) \$ _____

TOTAL FEE DUE: \$ 320.00

6. FEE PAYMENT

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7. FEE DEFICIENCY

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No. ~~4756 8461 9568 0263~~

American Exp.



Signature of Attorney

Registration No. 31,311

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Randy W. Tung

Tung & Associates
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Payment Amount: \$(US Dollars): \$ 320.00

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Date: 9-17-03

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Application No.

Application No.

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Patent No.

Patent No.

Registration No.

Attorney Docket No.

Identify or Describe Mark

09/822,532
67,200-390

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Applicant: Cheng-Wei Lee

Group Art Unit: 1765

Serial No.: 09/822,532

Examiner: Robert M. Kunemund

Filed: March 20, 2001

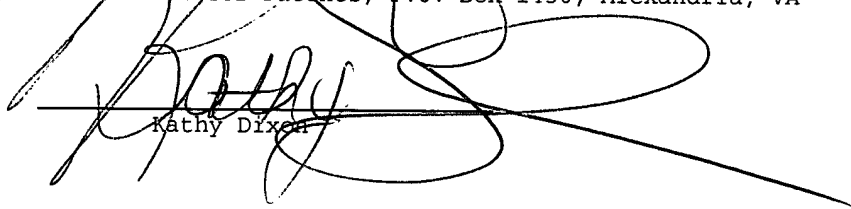
For: Method for Forming Aluminum Bumps by Sputtering and
Chemical Mechanical Polishing

Attorney Docket No.: 67,200-390

EXPRESS MAIL CERTIFICATE

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Date of Deposit September 17, 2003

I hereby certify that this paper in triplicate and a credit card payment form in the amount of \$320.00 (required filing fee) are being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR §1.10 on the date indicated above and is addressed to: Mail Stop: Appeal, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450



Kathy Dixon

APPEAL BRIEF

Box Appeal
Commissioner for Patents
Alexandria, VA 22313-1450

Sir:

Appellant appeals in the captioned application from the Examiner's final rejection dated April 17, 2003, of claims 1-20, under 35 USC §103(a) as being unpatentable over Chakravorty '569, Lin '916 and Wolf et al publication.

It is urged that the rejection be reversed and that all the claims be allowed.

U.S.S.N. 09/822,532

(1) REAL PARTY IN INTEREST

The real party in interest in the present appeal is the recorded Assignee of Taiwan Semiconductor Manufacturing Company, Ltd.

(2) RELATED APPEALS AND INTERFERENCES

There are no other appeals or interferences that are known to the Appellant, the Appellant's legal representative, or the assignee.

(3) STATUS OF CLAIMS

Claims 1-20 are pending in the application.

Claims 1-20 stand rejected. No claims stand allowed.

(4) STATUS OF AMENDMENTS

A Request For Reconsideration was filed on or about June 17, 2003.

An Advisory Action was received from the Examiner dated June 23, 2003 maintaining rejection of all claims.

A Notice of Appeal was filed on or about July 17, 2003.

(5) SUMMARY OF THE INVENTION

The invention is directed to a method for forming aluminum bumps by a method that requires substantially reduced number of processing steps which includes sputtering and chemical mechanical polishing.

(Specification, paragraph 001)

In a preferred embodiment, a method for forming aluminum bumps by sputtering and chemical mechanical polishing (CMP) can be carried out by the operating steps of providing a pre-process electronic substrate with a plurality of input/output (I/O) pads formed on a top surface; depositing an insulating material layer on top of the plurality of I/O pads to a thickness that is essentially the thickness of the aluminum bumps to be formed; photolithographically forming a plurality of openings with one on each of the plurality of I/O pads; sputter depositing a metal comprising Al filling the plurality of openings and covering a top surface of the insulating material layer; chemical mechanical polishing the electronic substrate until a plurality of Al bumps are formed with a top surfaces of the bump flush with the top surface of the insulating material layer; and removing at least partially a thickness of the insulating material layer by a wet etch process.

(Specification, paragraph 0016)

(6) ISSUE

Is the rejection of claims 1-20 under 35 USC §103(a) based on Chakravorty '569, Lin '916 and Wolf et al publication proper when such reference does not teach or suggest the specifically claimed limitations in the present application?

(7) GROUPING OF CLAIMS

The rejection of claims 1-20 are contested as a group.

(8) ARGUMENTS

Claims 1-20 are rejected under 35 USC §103(a) as being unpatentable over Chakravorty '569 in view of Lin '916 and further in view of Wolf et al publication. It is contended that Chakravorty substantially discloses the invention except a method for removing the insulating material by a wet etching process, and such is disclosed by Lin.

The rejection of claims 1-20 and under 35 USC §103(a) based on Chakravorty, Lin and Wolf et al is improper and must be reversed.

Chakravorty discloses a low cost chip size package wherein a plurality of metal bumps is formed on a semiconductor wafer containing a plurality of chips, each of the plurality of bumps is in electrical contact with a contact pad on one of the chips. Chakravorty further discloses the deposition of an encapsulant layer over the plurality of metal bumps and then polished to expose a top surface on each of the metal bumps. While the Appellant agrees with the Examiner that Chakravorty does not teach a method for removing the insulating material by a wet etching process, the Appellant must respectfully submit that Chakravorty further does not teach the deposition of the insulating material layer to a specific thickness, i.e. **a thickness that is substantially the thickness of aluminum bumps to be formed.**

Furthermore, while Lin discloses the etching of a polyimide layer to an angle of about 75°, Lin does not disclose the removal of "at least partially" a thickness of the insulating material layer. As clearly recited in the present invention independent claim 1:

"Claim 1. A method for forming aluminum bumps by sputtering and chemical mechanical polishing comprising the steps of:

providing a pre-processed electronic substrate ...;

depositing an insulating material layer on top of said plurality of I/O pads to a thickness that is substantially the thickness of Al bumps to be formed;

photolithographically forming a plurality of openings ...;

sputter depositing a metal comprising Al ...;

chemical mechanical polishing said electronic substrate ...; and

removing at least partially a thickness of said insulating material layer by a wet etch process."

Furthermore, in the present invention independent claim

12:

"Claim 12. A method for forming aluminum bumps on a semiconductor structure comprising the steps of:

providing a pre-processed semiconductor structure ...;

printing a layer of polyimide-containing material having a thickness of at least 5 μm on top of said structure;

forming a plurality of openings ...;

filling said plurality of openings ...;

removing excess metal from areas ...; and

removing at least partially said layer of polyimide-containing material by a wet etch process."

The Appellant respectfully submits that the art cited by the Examiner, i.e. Chakravorty, Lin and Wolf et al, even when combined, do not teach the present invention process steps of

"depositing an insulating material layer to a thickness that is substantially the thickness of aluminum bumps" (claim 1),

"printing a layer of polyimide-containing material having a thickness of at least 5 μ m on top of said structure" (claim 12), and

"removing at least partially a thickness of said insulating material layer" (claims 1 and 12).

In the Response to Arguments section of the 04/17/2003 Office Action, the Examiner stated "Applicant's argument concerning the thickness of the insulating material is noted. However, the Lin reference does teach that the insulating layer be about the same thickness of the bump. Also, the reference clearly, shows a polyimide layer thicker than 5 μ m as claimed". Throughout the Lin reference, the Applicant failed to find any support to substantiate the Examiner's statement. Lin teaches a method in which a polyimide polymer is used as an inter-metal dielectric layer (see Abstract) and then, as shown in Figure 8, a via 70 is etched in the polyimide layer 64 (col. 7, lines 42-48). The Lin reference has nothing to do with the building of solder bumps, or anything to do with the present invention in which a polyimide layer is used as a mold for molding solder bumps.

The Examiner further stated that "the Chakravorty reference does teach col. 11, that by using an etch method to control exposure at the bumps, which includes thinning the insulation material as claimed".

The Appellant respectfully submits that Chakravorty stated at col. 11, lines 1-18:

"The next step consists of exposing the metal bump regions 311 by removing the portions of encapsulant layer 312 which cover bumps 311. In one embodiment, that is achieved by **mechanically polishing** the encapsulated wafer in a polishing wheel with the slurry such as alumina. ... methodologies established in the area of chemical-mechanical polishing (CMP) could also be employed for a controlled process for exposure of the metal bump regions 313."

The Appellant failed to find any teaching by Chakravorty of using an etch method to remove the insulating material layer, let alone the teaching of the present invention of "removing at least partially a thickness of said insulating material layer by a wet etch process".

U.S.S.N. 09/822,532

The rejection of claims 1-20 under 35 USC §103(a) based on Chakravorty, Lin and Wolf et al is improper and must be reversed.

CLOSING

In summary, the Appellant has shown that his claimed invention is fully supported by a body of evidence of non-obviousness. It is respectfully submitted that such evidence of non-obviousness overcomes any showing of obviousness presented by the Examiner. The Appellant therefore submits that the final rejection of his claims 1-20 is improper under 35 USC § 103(a).

The reversal of the final rejection is respectfully solicited from the Board.

Respectfully submitted,

Tung & Associates

By: 

Randy W. Tung
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CLAIM APPENDIX

1. A method for forming aluminum bumps by sputtering and chemical mechanical polishing comprising the steps of:

providing a pre-processed electronic substrate with a plurality of input/output (I/O) pads formed on a top surface;

depositing an insulating material layer on top of said plurality of I/O pads to a thickness that is substantially the thickness of Al bumps to be formed;

photolithographically forming a plurality of openings with one on each of said plurality of I/O pads;

sputter depositing a metal comprising Al filling said plurality of openings and covering a top surface of said insulating material layer;

chemical mechanical polishing said electronic substrate until a plurality of Al bumps is formed with a top surface of the bump flush with said top surface of the insulating material layer; and

removing at least partially a thickness of said insulating material layer by a wet etch process.

2. A method for forming aluminum bumps by sputtering and chemical mechanical polishing according to claim 1 further comprising the step of forming said plurality of I/O pads in a metal comprising Al.

3. A method for forming aluminum bumps by sputtering and chemical mechanical polishing according to claim 1 further comprising the step of depositing said insulating material layer of a thickness of at least 5 μm .

4. A method for forming aluminum bumps by sputtering and chemical mechanical polishing according to claim 1 further comprising the step of depositing said insulating material layer of a material selected from the group consisting of silicon oxide, spin-on-glass and polyimide.

5. A method for forming aluminum bumps by sputtering and chemical mechanical polishing according to claim 1 further comprising the step of depositing said insulating material layer by at least two layers of different materials.

6. A method for forming aluminum bumps by sputtering and chemical mechanical polishing according to claim 1 further comprising the step of depositing said insulating material layer by a first layer of Si_3N_4 or SiO_2 and a second layer of polyimide on top of said first layer.

7. A method for forming aluminum bumps by sputtering and chemical mechanical polishing according to claim 1 further comprising the step of depositing said insulating material layer by at least two layers of different materials to a total thickness of at least 5 μm .

8. A method for forming aluminum bumps by sputtering and chemical mechanical polishing according to claim 1 further comprising the step of depositing said insulating material layer by at least two layers of different materials to a total thickness between about 5 μm and about 10 μm .

9. A method for forming aluminum bumps by sputtering and chemical mechanical polishing according to claim 1 further comprising the step of sputter depositing a metal that consists of Al and Cu.

10. A method for forming aluminum bumps by sputtering and chemical mechanical polishing according to claim 1 further comprising the step of sputter depositing a metal that consists of Al and less than 3 wt. % Cu.

11. A method for forming aluminum bumps by sputtering and chemical mechanical polishing according to claim 1 further comprising the step of conducting said wet etch process incorporating buffered oxide etch (BOE).

12. A method for forming aluminum bumps on a semiconductor structure comprising the steps of:

providing a pre-processed semiconductor structure with a plurality of I/O pads on top;

printing a layer of polyimide-containing material having a thickness of at least 5 μm on top of said structure;

forming a plurality of openings on each of said plurality of I/O pads exposed;

filling said plurality of openings with a metal comprising Al;

removing excess metal from areas other than said plurality of openings; and

removing at least partially said layer of polyimide-containing material by a wet etch process.

13. A method for forming aluminum bumps on a semiconductor structure according to claim 12 further comprising the step of forming said plurality of I/O pads in a metal comprising Al.

14. A method for forming aluminum bumps on a semiconductor structure according to claim 12 further comprising the step of printing said layer of polyimide-containing material by a screen printing or stencil printing technique.

15. A method for forming aluminum bumps on a semiconductor structure according to claim 12 further comprising the step of printing said layer of polyimide-containing material to a thickness between about 5 μm and about 10 μm .

16. A method for forming aluminum bumps on a semiconductor structure according to claim 12 further comprising the step of filling said plurality of openings with a metal comprising Al and Cu.

17. A method for forming aluminum bumps on a semiconductor structure according to claim 12 further comprising the step of removing excess metal until a surface of said metal in the plurality of openings is flush with a top surface of said layer of polyimide-containing material.

18. A method for forming aluminum bumps on a semiconductor structure according to claim 12 further comprising the step of removing at least partially said layer of polyimide-containing material by an etchant comprising HF and NH_4F .

19. A method for forming aluminum bumps on a semiconductor structure according to claim 12 further comprising the step of removing at least $\frac{1}{2}$ of a total thickness of said layer of polyimide-containing material to facilitate bonding to said Al bumps formed in said plurality of openings.

20. A method for forming aluminum bumps on a semiconductor structure according to claim 12 further comprising the step of removing completely said layer of polyimide-containing material to facilitate bonding to said Al bumps formed in said plurality of openings.